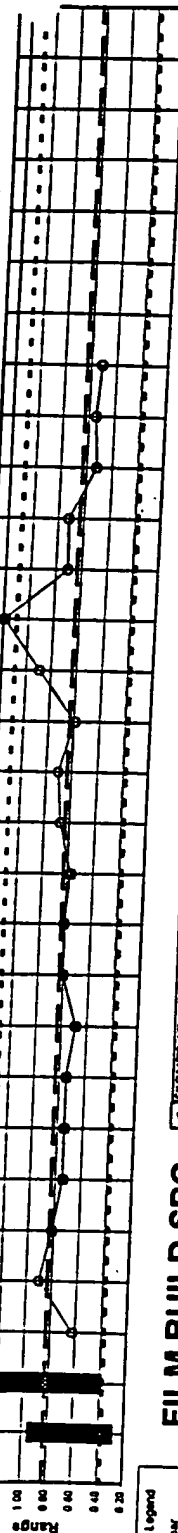
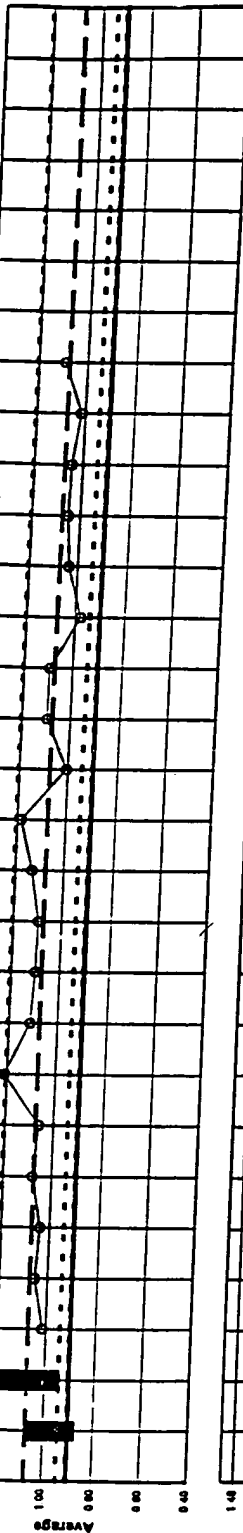
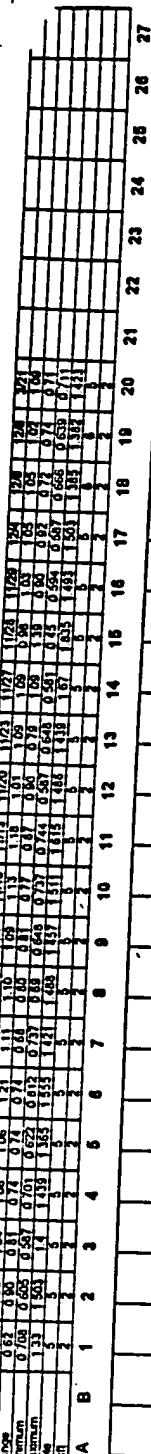
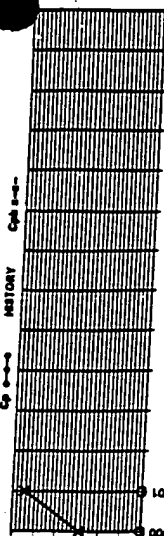


APPENDIX A

DATA PASSED NORMALITY TEST	YES	NO

REACTION PLAN



FILM BUILD SPC
PAINT APPLICATIONS TEAM

[illegible]

204770 22634007

APPENDIX B

INDIVIDUAL MOVING RANGE CONTROL CHART

NO. OF MEASUREMENTS PER HOUR
PELT GAGE
1.0

DATE CONTROL LIMITS CALCULATED FROM
MACHINE NO.
PRIME BOOTH
MACHINE NO.

LOCATION DATA COLLECTED
PELT BOOTH
LINE 11415

CALCULATED
CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

ELCOMETER

DEMO

INSTRUMENT SPECIFICATION

0.00 Minimum Unilateral

Point

22

Specific Point

Machine Frequency

25 HZ

Chart Columns

Film Build Anal YST

DISABLED

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATE
VALUE
RANGE
SHIFT

CL XBAR

USLA SL

Unit of Measure MIL

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

0.2

0

DATA PASSED NORMALITY TEST

YES NO

REACTION PLAN #

1.2

1

0.8

0.6

0.4

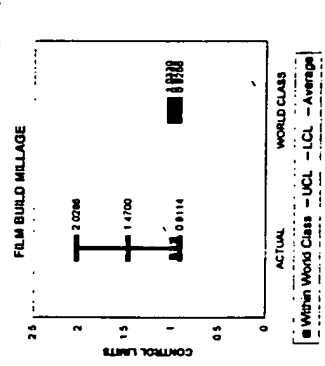
0.2

APPENDIX D

Film Build Cpk's Cost Impact Analysis

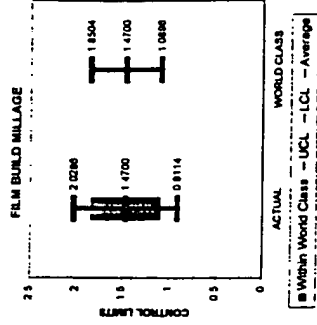
1ST PREMISE

VARIATION SELECTION	
1) Choose Variability	
2) Select First Target Range	
3) Average Adjusted to World Class Standard	
Coating: Taupe Prime	
Point: 22	
Booth: na	
Coating Min Spec:	0.9
Actual Average:	1.47
Actual Range:	0.21
Actual Cpk:	1.04
Target Range:	0.02
World Class Cpk:	1.5
Effect on Coating Usage	
-33.35%	
Approximate Annualized Cost Impact	
\$ (1,418.12)	



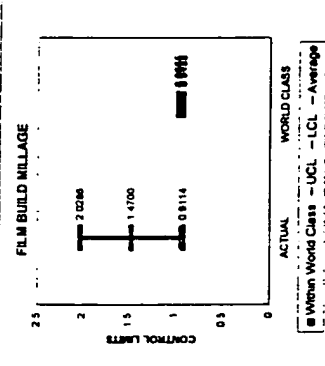
3RD PREMISE

VARIATION REDUCTION	
1) Variability Adjusted to World Class Standard	
2) Coating Usage Remains Constant	
3) Average Remains Constant	
Coating: Taupe Prime	
Point: 22	
Booth: na	
Coating Min Spec:	0.9
Actual Average:	1.47
Actual Range:	0.21
Actual Cpk:	1.04
New Range:	0.14
World Class Cpk:	1.5
Effect on Coating Usage	
0.00%	
Approximate Annualized Cost Impact	
\$ nil	



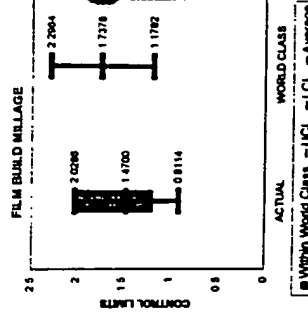
2ND PREMISE

VARIATION SELECTION	
1) Choose Variability	
2) Select Second Target Range	
3) Average Adjusted to World Class Standard	
Coating: Taupe Prime	
Point: 22	
Booth: na	
Coating Min Spec:	0.9
Actual Average:	1.47
Actual Range:	0.21
Actual Cpk:	1.04
Target Range:	0.01
World Class Cpk:	1.5
Effect on Coating Usage	
-38.08%	
Approximate Annualized Cost Impact	
\$ (1,531.52)	



4TH PREMISE

INCREASED MILLAGE	
1) Coating Usage Increases	
2) Variability Remains Constant	
3) Average Adjusted to World Class Standard	
Coating: Taupe Prime	
Point: 22	
Booth: na	
Coating Min Spec:	0.9
Actual Average:	1.47
Actual Range:	0.21
Actual Cpk:	1.04
New Average:	1.74
World Class Cpk:	1.5
Effect on Coating Usage	
18.22%	
Approximate Annualized Cost Impact	
\$ 774.81	



Cost per Unit Factors				
Coating: Taupe Prime	Point: 22	Usage per Unit (gal.): 0.27	Cost per Galon (\$): 30.00	Point %: 1.05
				Booth % Flow: 100
				Annualized Production (units): 200,000

APPENDIX E

CONSTANTS AND FORMULAS

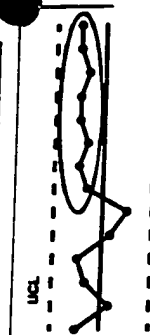
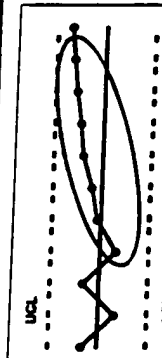
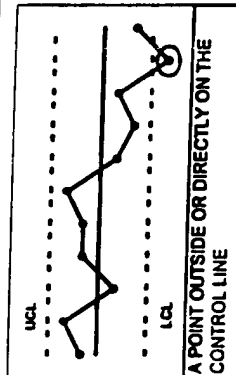
FORMULA FOR \bar{X} AND R CHARTS	
\bar{X} - Chart	R - Chart
$\bar{X} = \frac{\sum X}{n}$	$CLR = R = \frac{\sum R}{k}$
$CL\bar{X} = \bar{X} = \frac{\sum \bar{X}}{k}$	$UCLR = D_4 \times R$
$UCL\bar{X} = \bar{X} + (A_2 \times R)$	$LCLR = D_3 \times R$
$LCL\bar{X} = \bar{X} - (A_2 \times R)$	$\hat{\sigma} = \frac{R}{d_2}$
$Cp = \frac{USL - LSL}{6\hat{\sigma}}$	
$Cpk = \text{minimum of } \frac{USL - \bar{X}}{3\hat{\sigma}} \text{ or } \frac{\bar{X} - LSL}{3\hat{\sigma}}$	

CONTROL CHARTS FOR VARIABLE DATA

\bar{x}	Individual Measurement
$\bar{\bar{x}}$	Subgroup Average
$\bar{\bar{R}}$	Grand Average
Σ	Sum of
R	Range = Highest Value - Lowest Value
CL	Center Line
UCL	Upper Control Limit
LCL	Lower Control Limit
k	Number of Subgroups
n	Subgroup Size
$\hat{\sigma}$	Process Standard Deviation
A_2	Factor for \bar{x} Chart Limits
D_4	Factor for UCL on R Chart
D_3	Factor for LCL on R Chart
USL	Upper Specification Limit
LSL	Lower Specification Limit
d_2	Factor for estimating Process Standard Deviation

Chart X	
n	A ₂
Subgroup Size	Upper and Lower Control Limit Factor
2	1.880
3	1.023
4	0.729
5	0.577
6	0.483
7	0.419
8	0.373
9	0.337
10	0.308
11	0.285
12	0.266
13	0.249
14	0.235
15	0.223
16	0.212
17	0.203
18	0.194
19	0.187
20	0.180
21	0.173
22	0.167
23	0.162
24	0.157
25	0.153

Range Chart R			
n	d ₂	D ₃	D ₄
Subgroup Size	Estimate of Standard Deviation Divisor	Lower Control Limit Factor	Upper Control Limit Factor
2	1.128	na	3.270
3	1.693	na	2.574
4	2.059	na	2.282
5	2.326	na	2.114
6	2.534	na	2.004
7	2.704	0.076	1.924
8	2.847	0.136	1.864
9	2.970	0.184	1.816
10	3.078	0.223	1.777
11	3.173	0.256	1.744
12	3.258	0.283	1.717
13	3.335	0.307	1.693
14	3.407	0.328	1.672
15	3.472	0.347	1.653
16	3.532	0.363	1.637
17	3.588	0.376	1.622
18	3.640	0.391	1.608
19	3.689	0.403	1.597
20	3.735	0.415	1.585
21	3.778	0.425	1.575
22	3.819	0.434	1.566
23	3.858	0.443	1.557
24	3.895	0.451	1.548
25	3.931	0.459	1.541



CONSTANTS AND FORMULAS

APPENDIX F

Film Build Cpk's Cost Impact Analysis

1ST PREMISE

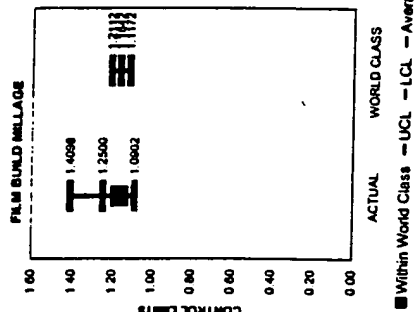
VARIATION SELECTION	
1) Choose Variability	
2) Select First Target Range	
3) Average Adjusted to World Class Standard	

Coating: Black Prime	
Panel: Hood	
Booth: na	

Coating Min. Spec.: 0.9	
Actual Average: 1.25	
Actual Range: 0.68	
Actual Cpk: 0.587	
Subgroup Size: 14	
Target Range: 0.2	
World Class Cpk: 1.5	

Effect on Coating Usage	-8.87%
-------------------------	--------

Approximate Annualized Cost Impact	\$ (3,754.55)
------------------------------------	---------------



3RD PREMISE

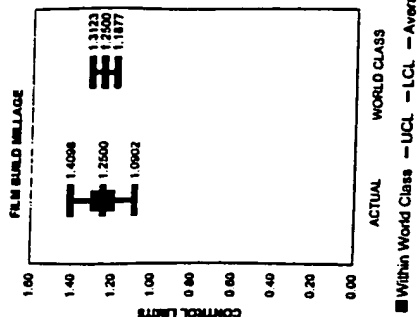
VARIATION REDUCTION	
1) Variability Adjusted to World Class Standard	
2) Coating Usage Remains Consistent	
3) Average Remains Constant	

Coating: Black Prime	
Panel: Hood	
Booth: na	

Coating Min. Spec.: 0.9	
Actual Average: 1.25	
Actual Range: 0.68	
Actual Cpk: 0.587	
Subgroup Size: 14	
New Range: 0.27	
World Class Cpk: 1.5	

Effect on Coating Usage	0.00%
-------------------------	-------

Approximate Annualized Cost Impact	\$ nil
------------------------------------	--------



2ND PREMISE

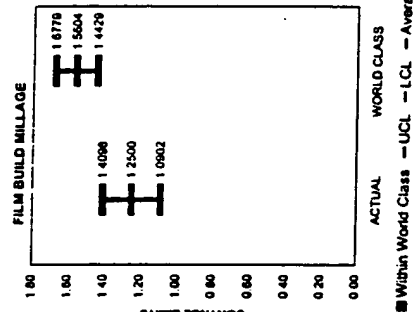
VARIATION SELECTION	
1) Choose Variability	
2) Select Second Target Range	
3) Average Adjusted to World Class Standard	

Coating: Black Prime	
Panel: Hood	
Booth: na	

Coating Min. Spec.: 0.9	
Actual Average: 1.25	
Actual Range: 0.68	
Actual Cpk: 0.587	
Subgroup Size: 14	
Target Range: 0.5	
World Class Cpk: 1.5	

Effect on Coating Usage	24.83%
-------------------------	--------

Approximate Annualized Cost Impact	\$ 13,577.12
------------------------------------	--------------



4TH PREMISE

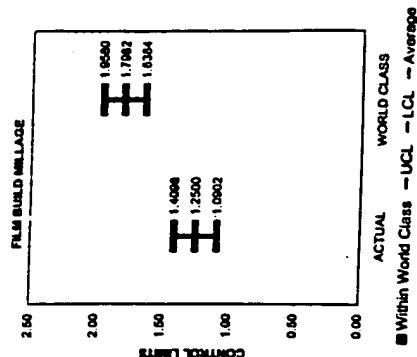
INCREASED MILLAGE	
1) Coating Usage Increases	
2) Variability Remains Constant	
3) Average Adjusted to World Class Standard	

Coating: Black Prime	
Panel: Hood	
Booth: na	

Coating Min. Spec.: 0.9	
Actual Average: 1.25	
Actual Range: 0.68	
Actual Cpk: 0.587	
Subgroup Size: 14	
New Average: 1.7982	
World Class Cpk: 1.5	

Effect on Coating Usage	43.85%
-------------------------	--------

Approximate Annualized Cost Impact	\$ 23,976.12
------------------------------------	--------------



Cost per Unit Factors:				
Coating: Black Prime	Usage per Unit (gal.): 0.27	Cost per Gallon (\$): 27	Coating Popularity %: 25	Panel %: 15
			Booth % Flow: 100	Annualized Production (Units): 200,000

APPENDIX G

Variability Reduction Tools

Automotive Facility

Booth 2 Clear Coat Film Build Cost Analysis

<u>Panel</u>	<u>Millage Adjusted, Variability Constant</u>	<u>Range Variability Adjusted: 0.10 Mills</u>	<u>Range Variability Adjusted: 0.20 Mills</u>
Left	\$ 214,576	\$ 7,333	\$ 25,674
Right	\$ 263,413	\$ 22,571	\$ 41,838
Hood	\$ 161,393	(\$ 39,670)	(\$ 23,712)
Roof	\$ 84,819	(\$ 19,053)	(\$ 505)
Deck	<u>\$ 40,453</u>	<u>(\$ 20,413)</u>	<u>(\$ 10,903)</u>
Totals:	\$ 764,654	(\$ 49,232)	\$ 32,392

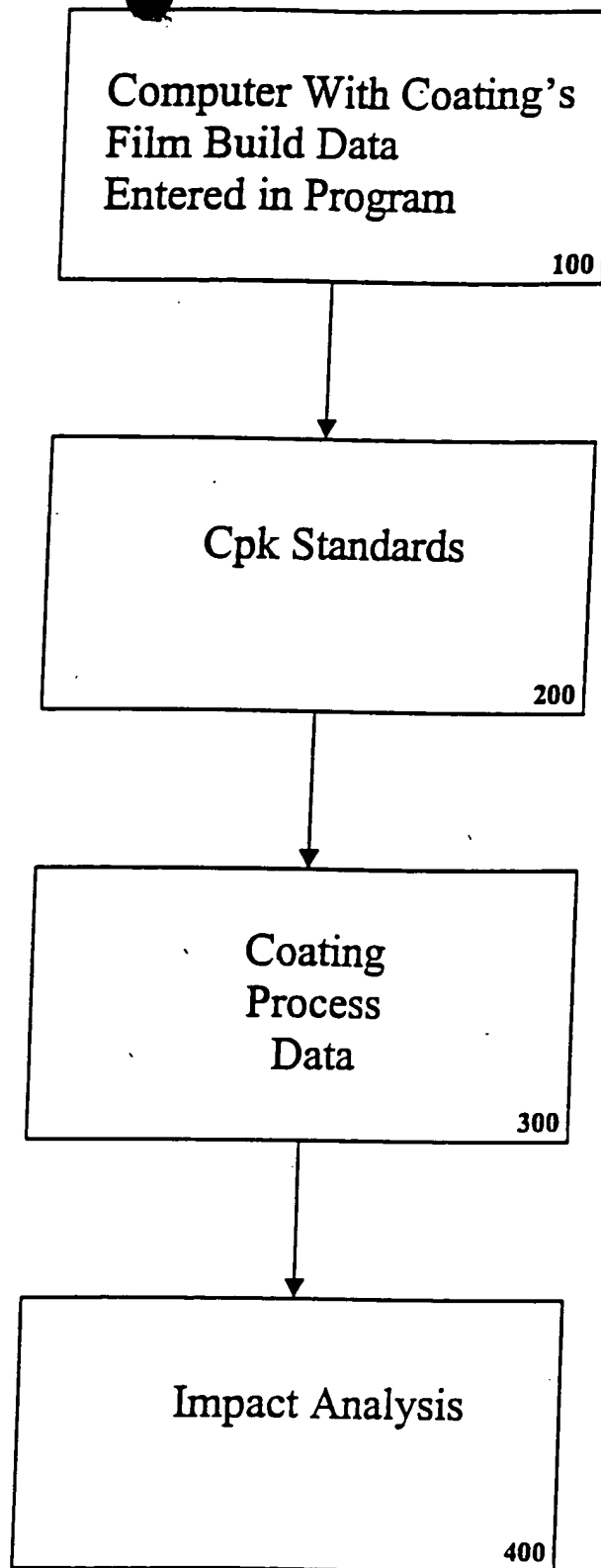


FIGURE 1

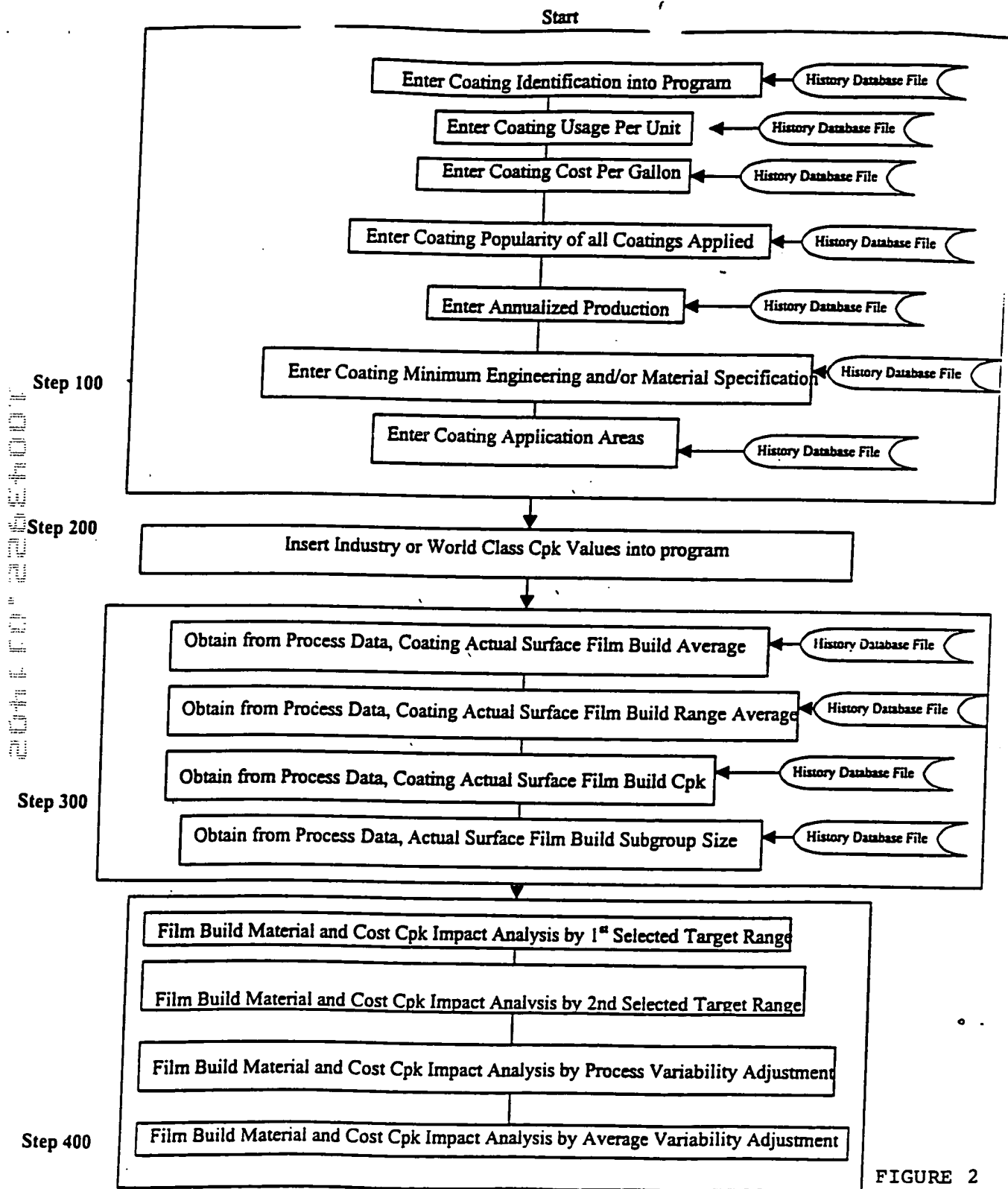


FIGURE 2